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Press Release

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ASTRONOMERS CONFIRM A "WATER FOUNTAIN" OF YOUTH

In a paper presented today at the 205th American Astronomical Society meeting in San Diego, California, astronomers Dr. Kevin B. Marvel of the American Astronomical Society (AAS) and Dr. David A. Boboltz of the United States Naval Observatory (USNO) are announcing the confirmation of a new and potentially young member of a rare class of objects previously dubbed "water fountain" sources. These aging red giant stars are thought to be in a short-lived transition phase of their evolution toward becoming a white dwarf star surrounded by a shell of glowing gas called a "planetary nebula". Only three such water fountain sources were previously known to exist, and these objects may provide important clues to understanding the mystery of how spherical stars are able to form such a diverse and beautiful array of planetary nebula shapes observed by professional and amateur astronomers alike.

Astronomers have long wondered how planetary nebulae with such descriptive names as the "Dumbbell", "Cat's Eye", "Butterfly", etc. were able to form from the circumstellar envelopes of their spherical progenitor stars. Unfortunately, the red giants from which these planetary nebulae form are typically enshrouded in a layer of dust, making optical observations nearly impossible. However, the atmospheres of many of these evolved red giants are enriched in oxygen from which molecules such as water (H_2O), Silicon Monoxide (SiO), Carbon Monoxide (CO), and Hydroxyl (OH) can form. Some of these molecules, in turn, emit maser radiation (the microwave equivalent of a laser), which is observable using ground-based radio telescopes. Astronomical masers allow radio astronomers to probe regions of the circumstellar envelope that are not accessible to telescopes operating at other wavelengths.

Drs. Boboltz and Marvel studied the star, named OH12.8-0.9, using the National Science Foundation's Very Long Baseline Array (VLBA) radio telescope. The star, which is located in the constellation Sagittarius, was previously suspected to be a "cousin" of so-called water fountain sources from observations of its emission spectra at radio wavelengths of 22 Gigahertz (the water maser line) and 1612 Megahertz (an OH maser line).

"The spectral characteristics of the water and OH maser emission are similar to other sources in this class, but no information on the location of the masers around the star was available," said Boboltz who initiated the study of OH12.8-0.9. In fact, very little at all is known about the star including its distance from the Earth.

It took the resolving power of the sharpest radio "eye" on the planet, the VLBA, to enable the two astronomers to map the positions of the water masers and confirm that OH12.8-0.9 indeed has the structural characteristics of a water fountain source. "The water masers are clustered in two compact regions oriented nearly north-south on the sky as one might expect if they were tracing jets squirted out the poles of the star," said Marvel. It is this jet or fountain-like structure probed by the water masers that gives these sources their name.

Because the velocity difference between the two clusters of masers is significantly less than that of other water fountain sources, it may be that OH12.8-0.9 represents the early onset of this evolutionary jet-forming stage. These jets are also thought to provide a mechanism for the formation of the wide variety of shapes exhibited by planetary nebulae.

Marvel and Boboltz have yet to confirm that the OH masers occupy a smaller region on the sky than the water masers as is typical for these sources. Pending observations using the National Science Foundation's Very Large Array should verify this characteristic structure. Future VLBA observations of the water masers should enable the two to study the motions of the masers on the sky as a function of time to determine characteristics such as jet speeds and any twists and turns the fountain might undergo.

The National Science Foundation's Very Long Baseline Array consists of ten separate radio telescopes that operate in conjunction with each other to act as a single radio telescope with an effective aperture equivalent to the distance between their most widely-spaced elements in Hawaii and the U.S. Virgin Islands. It is currently the most powerful radio telescope on the planet.

Image courtesy of NRAO/AUI